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Report No. 11530

PROJECT COMPLETION REPORT

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT
(LOAN 2491-KO)

JANUARY 11, 1993

Infrastructure Operations Division
Country Department I
East Asia and Pacific Regional Office

CURRENCY AND EQUIVALENTS

Currency Unit	=	Won (W)
US$1.00	=	W 870 (1985 average)
	=	W 881 (1986 average)
	=	W 823 (1987 average)
	=	W 731 (1988 average)
	=	W 671 (1989 average)

WEIGHTS AND MEASURES

meter (m)	=	3.28 feet
kilometer (km)	=	0.62 miles
square kilometer (sq km)	=	0.39 square miles
hectare (ha)	=	10,000 square meter
cubic meter (cu m)	=	264 US gallons
cubic meters per sec. (cu m/s)	=	22.82 million US gallons per day
Gigawatt hour (GWh)	=	1 million kilowatt hours (kWh)
liter (l)	=	0.26 US gallons
liters per capita per day (lcpd)	=	0.26 gallons per capita per day
milligrams per liter (mg/l)	=	parts per million (ppm)
metric ton (mt)	=	2,205 lb or 1 cubic meter of water
metric tons per day (mtpd)	=	2,205 lbs per day or 264 US gallons per day

ABBREVIATIONS

ADB	=	Asian Development Bank
DRP	=	Design Review Panel
EPB	=	Economic Planning Board
ERR	=	Economic Rate of Return
ICB	=	International Competitive Bidding
IMC	=	Inter-Ministerial Committee
ISWACO	=	Industrial Sites and Water Resources Development Corp.
KDB	=	Korea Development Bank
KECC	=	Korea Engineering Consultants Corporation
KEPCO	=	Korea Electric Power Company
KOWACO	=	Korea Water Resources Corporation
MOC	=	Ministry of Construction
MOF	=	Ministry of Finance
MOHA	=	Ministry of Home Affairs
MOHSA	=	Ministry of Health and Social Affairs
OECF	=	Overseas Economic Cooperation Fund of Japan
OOE	=	Office of the Environment
RCMA	=	MOC's Regional Construction and Management Agency
UNDP	=	United Nations Development Program
WB	=	Water Bureau

THE WORLD BANK
Washington, D.C. 20433
U.S.A.

Office of Director-General
Operations Evaluation

January 11, 1993

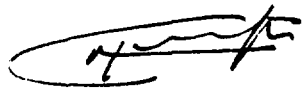
MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

SUBJECT: Project Completion Report on Korea
Metropolitan Region Water Supply Project (Loan 2491-KO)

Attached is a copy of the report entitled "Project Completion Report on Korea - Metropolitan Region Water Supply Project (Loan 2491-KO)" prepared by the East Asia and Pacific Regional Office with Part II contributed by the Borrower.

All objectives of the project were achieved. Implementation of the physical components was exemplary. Benefits from the project facilities, in terms of improved water supplies in the Metropolitan Region of Seoul, were immediate and substantial. Studies carried out under the project on: (a) the reorganization of the water sector; (b) improving the organization and management of the implementing agency; and (c) rationalizing bulk water tariffs were executed satisfactorily and their recommendations accepted. Implementation of a) has been slow due to the issue's political sensitivity. However, those of (b) and (c) were effective. All in all, the project is rated as satisfactory and sustainability of its benefits as likely.

The Project Completion Report is comprehensive and informative. The brief Part II, prepared by the borrower acknowledges the Bank's significant contribution to the Korean water sector. The project is being audited together with Loan 2615-KO.



Attachment

PROJECT COMPLETION REPORT

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT (LOAN 2491-KO)

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PROJECT COMPLETION REPORT

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT (LOAN 2491-KO)

Preface

This is the Project Completion Report (PCR) for the Metropolitan Region Water Supply Project in the Republic of Korea, for which Loan 2491-KO in an amount of US$95.0 million was approved on February 5, 1985. The loan was closed on May 24, 1991, one year and five months behind schedule. US$89.3 million of the loan was disbursed, and US$5.72 million was canceled.

The PCR was prepared jointly by the Infrastructure Operations Division, Country Department I, East Asia and Pacific Regional Office (Preface, Evaluation Summary, Parts I and III), and the Borrower (Part II). The PCR is based on the Staff Appraisal Report for the project, the Loan Agreement, supervision reports, correspondence between the Bank and the Borrower, and internal Bank memoranda.

PROJECT COMPLETION REPORT

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT (LOAN 2491-KO)

Evaluation Summary

i. Background. In 1983, when this project was identified, 37% of the Korean population lived in the Seoul Metropolitan Region, which included Seoul and Incheon (the first and fourth largest cities), 38 other cities and towns as well as many villages. In contrast to the rest of the country, which had an average population growth rate of 2.1% during the previous 20 years, the population of the 25 municipalities included in the project had grown by an average 7.1% p.a. during the previous decade, and four municipalities had grown by over 10% p.a. Access to water services in the Region was uneven. About 96% of the population of Seoul City had house connections, but overall only about 77% of the population in the project area was served by connections. Demand for water in the project municipalities had outpaced water production capacity, resulting in water rationing and low pressures as well as serious conflicts among the various cities (Part I, paras. 1-3).

ii. Objectives. The project was intended to relieve water shortages and expand the water supply to satisfy the residential and industrial needs of 25 municipalities in the Seoul Metropolitan Region. It was expected to improve services to 5 million people and to raise the population served with water supply from 77% in 1983 to 92% in 1991 by providing bulk water for 1.1 million additional persons by 1991. Other project objectives were geared to institution building and sustainability: (a) to establish a basis for an integrated treated water system; (b) to improve the efficiency of water services in the Metropolitan Region; (c) to strengthen the organization of Korea Water Resources Corporation (KOWACO), the institution responsible for operating the country's bulk water systems serving groups of municipalities (as in the Metropolitan Region); and (d) to rationalize the policy and criteria for setting national bulk water supply tariffs (Part I, paras. 9-10 and 14).

iii. The project comprised the third stage of development of the bulk water supply system for the Metropolitan Region. It included the construction and equipping of: (a) a main water intake and booster pumping station, about 11 km of water transmission pipelines and three tunnels with a total length of 6.5 km, delivering water to three water systems; (b) the three water supply systems; (c) another treated water system, including an independent water intake, water treatment plant, booster pumping station, treated water transmission pipeline and tunnel; (d) technical assistance for project construction, design, supervision and management; and (e) studies to (i) improve the organization of water and sewerage services in the Metropolitan Region; (ii) establish corporate planning within KOWACO; and (iii) set policies for bulk water tariffs (Part I, paras 11-12).

iv. Implementation. Project preparation and implementation of the physical components went largely as planned. During preparation, Bank review of project designs was instrumental in assisting the Government to select the least-cost design option. The only change in the project during implementation was the extension of the system to an additional community experiencing water shortages due to unexpected population growth. The additional time needed for this work as well as some minor implementation and procurement delays caused the closing date for the loan to be extended by one year to December 1990. The delay had only a marginal effect on project benefits, since most of the municipalities were enjoying improved water service by end-1989 (Part I, para. 19).

v. The project studies to achieve institution building and sustainability objectives were carried out satisfactorily as agreed. However, while KOWACO strengthened its financial management, tariffs did not keep up with inflation. The study to improve the organization of water and sewer services in the Metropolitan Region was expanded to include a reorganization of water and sewer systems nationwide, with the aim of shifting responsibility for water supply distribution from the individual municipalities to regional entities encompassing several contiguous municipalities, as in the Seoul Metropolitan Region. The regional systems were promoted as a means to address increasing problems of water scarcity. However, the recommendations of the study were not implemented due to a lack of consensus on the reorganization (Part I, paras. 23-25).

vi. Project Results. The physical works were carried out substantially as planned and the quantitative objectives of the project were achieved. An unexpected rapid growth in the Metropolitan Region's population and water demand, however, made it necessary to advance construction of the next (fourth) stage expansion of the water system, even before this project was completed (Part I, para. 26). While the recommendations of the organizational studies have not yet been implemented, sector management and KOWACO has been continuously improving, and a number of progressive steps were taken during and after the project implementation period (Part I, paras. 27-29).

vii. Compliance with financial covenants included in the Loan Agreement was mixed, in some years the financial rate of return was higher than the covenanted rate of return, and in other years, lower. Always, however, the financial performance has been satisfactory in terms of meeting operating and maintenance costs, debt service and development obligations (Part I, paras. 30-35; Part III, Table 9).

viii. The economic rate of return at project completion was about 21%, higher than the appraisal estimate of 19%. This rate of return, however, underestimates the economic benefits of the project (Part I, para. 36).

ix. Sustainability. When politically feasible, the recommendations of the project's tariff and institutional studies should be implemented to ensure the sustainability of the physical infrastructure built under the project. Water resources in Korea are becoming scarce, and conservation practices need to be put in place as soon as possible (Part I, para. 38).

x. Conclusions and Lessons Learned. The physical components of the project were timely and well designed, and execution was excellent. The studies were well conceived, and although the recommendations were not implemented in most cases, they served to highlight important sector issues.

xi. There are two lessons to be learned from this project. First, good project design is crucial to the successful and timely implementation of the related physical components. Use of design panels for large, complex projects is likely to improve the projects (Part I, para. 15). Second, actions by mature Governments on politically sensitive policy changes with respect to reorganizations and tariffs are apt to come slowly, and the best role the Bank can play is to encourage and advise (Part I, paras. 45-46).

PROJECT COMPLETION REPORT

KOREA

METROPOLITAN REGION WATER SUPPLY PROJECT (LOAN 2491-KO)

PART I. PROJECT REVIEW FROM THE BANK'S PERSPECTIVE

Project Identity

Project Name:	Metropolitan Region Water Supply Project
Loan Number:	2491-KO
RVP Unit:	East Asia and Pacific Region
Country:	Republic of Korea
Sector:	Water Supply and Sanitation

Background

1. In 1983, when the Metropolitan Region Water Supply Project was identified, Korea had a population of about 40 million, some 37% of whom lived in the 3,000 km^2 Seoul Metropolitan Region. The Region included Seoul and Incheon, the first and fourth largest cities in Korea at that time, 38 other cities and towns, as well as many villages in Gyeonggi Province. Over the previous 20 years, the population in the Region had grown by an annual average rate of 5%, compared to 2.1% for the country overall. The population of the 25 municipalities included in the project had grown by 7.1% p.a. during the previous decade, with four municipalities growing by over 10% p.a.

2. Access to water services in the Region was uneven. About 96% of the population of Seoul City had house connections, but only 74% of the population in the other 39 cities and towns were served by connections, and several towns and villages were totally unserved by a piped water supply. Water production in the Metropolitan Region in 1983 reached 1,361 million metric tons (mt), serving 12 million of the Region's population (or 89% of the area's population). By 1983, in the project municipalities, demand had exceeded water production capacity, resulting in water rationing and low pressures as well as serious conflicts among the various cities served, and only about 77% of the population in the project area was served.

3. The Han River was the source of 98% of the water used in the Metropolitan Region, most of which (60% or 2.6 million metric tons per day (mtpd)) was provided by two regional water supply systems. Total water consumption in 1982 was 752 million mt or about 47 m^3 per month per connection. The main demand was domestic (55%), followed by commercial and industrial (35%) and public and others (10%). As a result of development of a third regional water supply system under the project, water consumption was expected to rise from 173 liters per capita per day (lpcd) in 1983 to 280 lpcd by 1996 (according to the feasibility study) or, more conservatively, to 230 lpcd as projected by the Bank at project appraisal.

4. At the time of project preparation (and even now), there was no single agency in charge of overall planning and programming of the sector. At the Central Government level, four Ministries were directly involved in the sector with some overlapping responsibilities. The Ministry of Construction (MOC), the main agency for the sector, through its Water Resources and Urban Planning Bureaus, was responsible for the planning, design and construction of

major water and sewerage works and for collecting hydrological data, issuing licenses for abstraction of water from the major rivers and planning multi-purpose dams. The Industrial Sites and Water Resources Development Corporation (ISWACO), a semi-autonomous public corporation under MOC, was responsible for the operation of bulk water systems serving groups of municipalities, for the development of multi-purpose dams and land development.

5. The Ministry of Home Affairs (MOHA), through its Local Finance Bureau, oversaw the operation of municipal Water Bureaus (WBs), including the approval of bonds, loans, tariffs and the expansion of distribution and storage facilities. The Ministry of Health and Social Affairs (MOHSA) was responsible for setting standards and quality control. Finally, the Economic Planning Board (EPB) set guidelines for tariff increases through its Price Bureau and allocated counterpart funds for MOC's foreign-funded projects.

6. In 1988, the Government streamlined several public corporations and established the Korea Water Resources Corporation (KOWACO) as the main agency responsible for water resources and bulk water supply, while centralizing responsibility for land development in the Korea Land Development Corporation. The current acronym, KOWACO, is used hereafter in this report.

7. KOWACO is a corporation owned by the Government (94%) and the Korea Development Bank (KDB) (6%). KOWACO has two divisions, the Water Division and the Dams Division. The Water Division operates and maintains the regional water supply systems financed by MOC. Regional systems became necessary due to water scarcity in many areas. As of 1990, there were 13 regional systems, including three in the Metropolitan Region. The Dams Division operates and maintains eight dams and the Nakdong Barrage; two additional dams will be in operation by 1993. Its main source of revenue is the sale of bulk power to the Korea Electric Power Company (KEPCO).

8. Prior to the Metropolitan Region Project, the Bank had supported two water supply projects in Korea: the First Water Supply Project (Ln. 2072-KO, approved in 1981) to expand the systems in the cities of Daegu, Gwangju, Masan, Changweon and Jinhae; and the Second Water Supply Project (Ln. 2350-KO, approved in October 1983) to increase water availability for municipalities in the Nakdong Basin. These projects demonstrated the capacity of the sector to implement major physical works efficiently with little or no delay.

9. The Bank's dialogue with the Government over the course of the Bank's involvement with the sector centered largely on institutional issues including: (a) the lack of a mechanism to provide municipal Water Bureaus with long-term finance for investments; (b) the need for more rational criteria for setting bulk water tariffs by KOWACO, and retail water tariffs by the municipalities; (c) the lack of a single government agency responsible for the sector; and (d) improvement of the efficiency of the organization of the sector at the municipal level. While cost recovery in the Korean water supply sector was, and continues to be, excellent, the tariff policies have not been directed toward more efficient use of scarce national water resources.

Project Objectives and Description

10. Project Objectives. The project was regarded as an integrated solution to the water needs of municipalities in the Metropolitan Region which lacked other water sources. It was also a vehicle for continuing dialogue with key government ministries about improving sector coordination, institutional development and national tariff policies. The objectives of the project were to: (a) relieve water shortages and expand the water supply to satisfy the residential and industrial needs of 25 municipalities in the Seoul Metropolitan Region, thus improving services to 5 million persons and raising the population served with water supply from 77% in 1983 to 92% in 1991 by providing bulk water for 1.1 million additional persons by 1991; (b) establish the basis for an integrated treated water system; (c) improve the efficiency of water services in the Metropolitan Region; and (d) strengthen the organization of KOWACO and provide a more rational policy and criteria for nationwide tariffs for raw and treated bulk water supply.

11. Project Description. The project comprised the third stage of development of the bulk water supply system for the Metropolitan Region, using water extracted from the Han River, which at that time was judged to have sufficient water to satisfy demand at least to the year 2000. The project included the construction and equipping of:

(a) a main water intake and booster pumping station for 1,200,000 mtpd at Paldang, water transmission pipelines about 11 km long and 2,200 mm in diameter and three tunnels 6.5 km long and 3,800 mm in diameter, delivering water to three water systems described in (b), (c) and (d) below;

(b) the Incheon water system serving five municipalities to the west and including a booster pumping station, 560,000 mtpd capacity and water transmission pipelines 29 km long and 2,400 mm to 1,650 mm in diameter, and three tunnels 6.5 km long and 3,000 mm in diameter (the treatment plant for this system would be built, owned and operated by these municipalities);

(c) the Seongnam treated water system serving ten municipalities to the south and including a water treatment plant of 425,000 mtpd capacity, a booster pump station, and a treated water transmission pipeline about 48 km long and 1,800 mm to 1,350 mm in diameter;

(d) about 215,000 mtpd raw water supply to three municipalities and the new Banweol development area;

(e) the Euijeongbu treated water system serving six municipalities to the north and including an independent water intake from the Han River, a water treatment plant of 100,000 mtpd capacity, a booster pumping station, a treated water transmission pipeline about 24 km long and 1,100 mm to 900 mm in diameter and a tunnel 1.0 km long and 2,200 mm in diameter;

(f) technical assistance for project construction, design, supervision and management; and

(g) studies to i)improve the organization of water and sewerage services in the Metropolitan Region; ii)establish corporate planning within KOWACO and iii)set policies for bulk water tariffs.

12. Complementary Works. Six large project cities (Incheon, Seongnam, Suweon, Banweol, Bucheon and Gwangmyeong) and the Pyeongtaek development area were expected to use about 80% of the water supplied by the project. These cities, with consultant support, would prepare Master Plans and staged programs with assistance from MOHA for improvement and expansion of the existing distribution systems. Incheon, Bucheon and Gwangmyeong would construct a jointly-owned treatment plant with financing from the Asian Development Bank (ADB). All other beneficiary municipalities in the Region, coordinated by MOHA, were to prepare feasibility studies and expand their distribution systems to utilize the water supplied by the project.

Project Design and Organization

13. Least-cost Solution. Adoption of the least-cost solution was a major issue during project preparation. This issue, identified by early Bank missions reviewing completed project feasibility studies, was continuation of an established practice of lengthy transport of raw water from river intakes on the Han River to water treatment plants owned and operated by several contiguous municipalities. This practice had been employed in the two previous stages of system development. The Bank's analysis indicated that such a system would be at least 20% more expensive than a treated water system, and the Bank informed the Government that Bank financing for the project would be possible only if the lower-cost solution of a treated water transmission system was chosen. The final solution allowed for a short raw water pipeline to connect with an existing first-stage pipeline to increase water supply to Seoul. The rest of the project, however, was based on a treated water transmission and distribution system, whereby water would be treated at central plants and then distributed to the municipalities. Agreement on this change in basic design concept was a critical accomplishment in project development.

14. Studies. The project included the following studies: (a) to develop a maintenance and inspection program for Stages I, II and III of the Metropolitan Region Water Supply System; (b) to identify means of strengthening KOWACO's financial management and corporate planning capacities; and (c) to recommend policies for setting bulk water tariffs at the national level. All of these studies were to be undertaken and financed by KOWACO. A study of the organization of water service in the Metropolitan Region was to be prepared and financed by MOHA. The MOHA study was expanded later to include a reorganization of all water and sewerage systems in the country, with a particular aim of shifting responsibility for water supply distribution from the individual municipalities to regional entities encompassing several contiguous municipalities, as in the Seoul Metropolitan Region. All of the studies were to be carried out with the assistance of consultants (Part III, Table 9).

15. Design Review Panel. Feasibility studies and final engineering for the project were carried out by consultants financed under the First Water Supply Project (Loan 2072-KO). The large treatment plants included in the project posed a number of difficult design problems related to the approximately 14 km of tunnels, optimal routing of the large diameter and long transmission pipelines for treated water, optimum pipe sizing and choice of suitable pipe materials, water quality and corrosion protection throughout the nearly 175 km of pipeline. To ensure adequate solutions to these problems, the Bank proposed and the Government agreed to an expert international design review panel to review the engineering designs. Inputs from the panel contributed to the sound technical design, and consequently trouble-free commissioning, operation and maintenance of the completed system. A study was also carried out of cathodic protection against corrosion of all steel pipelines laid in the system's three stages.

16. Project Management. MOC managed the project efficiently. The complementary works were also implemented by the municipalities in a timely manner under the management of MOHA. In retrospect, agreement of the implementing agencies, consultants and Bank to advance contracting and packaging contracts into four lots so as to obtain the maximum benefit from the procurement process were important elements. The early tendering and start-up helped to achieve a firmer estimate of project costs at the outset and to reduce the provision for price contingencies. During negotiations, the loan amount was revised downwards from US$120 million equivalent to US$95 million equivalent, partly based on offers received on the first tenders and a tightening up of the project execution schedule.

17. Design Changes. Some minor changes were required during detailed design and project execution; details are in Annex 1. Project execution proceeded smoothly with no delays during the construction period. However, at the end of 1988, the Bank agreed to the Government's request to extend the system to include the municipality of Pyeongtaek, which was experiencing water shortages because of unexpected population growth. The extension to Pyeongtaek contributed to a delay in project completion due to the need for new designs, the emergence of land acquisition problems and the need to coordinate the pipeline alignment with a proposed new highway.

Project Implementation

18. Loan Effectiveness and Project Start-up. Project start-up commenced well before loan signing. Construction of civil works under the four project contracts began on November 30, 1984, April 13, 1985, October 11, 1985 and December 17, 1987, respectively. The loan was signed on March 11, 1985 and became effective on May 7, 1985. Since all bid documents, tender evaluations and contract awards for the first contract had been reviewed and approved by Bank staff, disbursement against the first contract was possible as soon as the loan was declared effective.

19. Implementation Schedule. The provision for advance contracting was a significant factor in reducing implementation delays and in achieving most of the project's objectives by the original loan closing date. Procurement was smooth, and contracts for all four lots were awarded on schedule. About 90% of the original project was completed by December 31, 1988, the original

completion date, and all major construction under the revised project was substantially completed by December 31, 1989, the original loan closing date. The closing date which had been extended to December 31, 1990 due to the Pyeongtaek extension, was also necessary because of delays in laying a pipeline under the Han River, in building a railway crossing, and in procuring electro-mechanical and laboratory equipment. This delay had no significant impact on project results since by December 31, 1989 about 92% of the Bank loan had been disbursed and most of the project municipalities had satisfactory water service. A comparison of the estimated and actual implementation schedules as well as the progress of the four contracts are shown in Annexes 2 and 3.

20. Project Costs. At the time of appraisal, the project was expected to cost US$252.1 million equivalent (including US$11.5 million equivalent in duties and taxes). Despite the additional works for the Pyeongtaek extension, the final project cost was about US$239.3 million equivalent (Part III, Table 5B). The cost under-run is attributed to the highly competitive local construction industry, timely project execution, and expeditious procurement procedures.

21. Disbursements. Disbursements exceeded appraisal estimates in the first three and a half years of project implementation and never dropped below 92% thereafter (Part III, Table 3A). Loan disbursements for civil works and consultants were lower than expected by 19% and 25%, respectively, but were 1% higher for equipment (Part III, Table 3B). In all, US$5.72 of the original US$95 million loan was canceled: US$5.0 million on April 3, 1989 and US$0.72 on May 1, 1991. At loan closing on May 24, 1991, US$89.8 million of the loan had been disbursed.

22. Financing. As expected at appraisal, the project was financed by the Bank loan (37%) and government equity (63%) (Part III, Table 5).

Project Results

23. Project Studies. The project studies were expected to contribute to: (a) establishment of a basis for integrated water systems; (b) improvement of KOWACO's efficiency; and (c) adoption of a more rational policy and criteria for nationwide tariffs. The reorganization studies (para. 14) were completed, regional water systems were recommended and implementation plans were discussed with all relevant agencies. Changes in top government officials and opposition by Congress, however, resulted in the shelving of the reorganization plans. This was not totally unexpected; the Staff Appraisal Report had noted that reorganization of this sector in Korea was a very sensitive political issue and that changes would be slow.

24. Study (b) contributed to improvements in KOWACO's efficiency by identifying measures to strengthen its financial management and corporate planning. As recommended by the studies, KOWACO began to prepare semi-annual plans and long-term financial projections, which were considered satisfactory by the Bank.

25. The tariff studies resulted in implementation of national uniform bulk water tariffs which would allow KOWACO's Water Division to achieve financial performance levels equivalent to those required by the Bank. Policies which would allow bulk water tariffs in each region to reflect actual costs were evaluated also, but that concept was dismissed as being socially inequitable and politically impossible.

26. Physical Results. The project was expected to improve services to 5 million people and provide bulk water for an additional 1.1 million people by 1991. Except for the addition of the extension to Pyeongtaek (para. 17), the physical works were carried out substantially as planned and the quantitative objectives were achieved. However, an unexpected rapid growth in the Region's population and in demand for water, caused by a change in the Government's spatial development policy, necessitated advancing construction of the next (fourth stage) expansion of the system, even before completion of the Bank-assisted third stage project. Appraisal projections of population growth and water demand therefore proved to be too low.

(a) Population Growth. During project implementation, the Government apparently reversed its policy of limiting growth in the Metropolitan Area, and by 1990 the population of the project municipalities was about one million more than expected at appraisal and by 1993 should exceed the forecast by almost three million. Part III, Table 6 gives the incremental population served by the project, and Annex 4 shows the unexpectedly high growth in the project area near the end of the project period.

(b) Water Demand. Annex 5 shows a comparison of average water demand as forecasted at project appraisal and as recently calculated by consultants based on actual population growth trends. The ultimate total supply capacity of the system after project completion in 1990 was about 1.35 mmtpd (million metric tons per day). In 1991, total average demand already exceeded the forecast (1.69 mmtpd) and is expected to reach almost 2.1 mmtpd by 1995.

The Bank could not have foreseen the Government's policy changes which caused demand in the project area to greatly outpace projections. Because of the quality of the planning of the overall system, preliminary designs for the fourth stage were available for immediate implementation. The project was therefore timely and assisted the Government in meeting its development objectives.

27. Institutional Results. KOWACO has been a continuously improving its organization, to which the Bank, through this and other projects, (Part III, Table 1) appears to have made important contributions. The whole problem of efficient water resource management and efficient provision of adequate services to the population, while trying to maintain a balance between social and economic factors, have been a high priority concern to the Government for many years. The establishment of KOWACO as part of a process of streamlining public corporations (para. 6), though possibly not directly attributable to Bank financed operations, is an example of this effort. While implementation

of the recommendations of the organizational studies (para. 23) were not considered possible at that time, other developments since then are promising.

28. After a review of the status of the sector, particularly the rapid increase of river pollution, the Government, in 1989, formulated a National Water Improvement Program (NWIP) with the objectives of insuring good quality water to the total population and improving the efficiency of the sector. The NWIP, comprising a fundamental reorganization of the sector, was approved by the President in September 1989, and its implementation was to be coordinated by the Prime Minister and an Inter-ministerial committee. Under NWIP, the municipal WBs are gradually being replaced by Water Agencies which would have the advantages of corporations, although remaining under the municipalities. Responsibility for municipal sewerage would be assumed by the Water Agencies as sewerage operations become financially viable.

29. During the early 1990's, the planning, construction and financing of all dams and regional water supply systems are to be transferred from MOC to KOWACO. Therefore, after construction of ongoing systems is completed (largely financed by Government contributions), KOWACO would have to finance future investments from internal cash generation and through borrowing. It has also been recommended, but not yet decided, that KOWACO should have full responsibility for management of the main rivers and the construction and operation of new sewage treatment plants. This step would substantially improve water resources management.

30. Financial Results. Under the Loan Agreement, KOWACO's minimum rates of return on revalued assets for its Water and Dams Divisions were to be 4% in 1985 and 5% thereafter, and KOWACO's debt service coverage would not be less than 1.3. The rate of return requirements for the Water Division were superseded by the Loan Agreement for the Juam Regional Water Supply Project (Loan 3178-KO) which required rates of return of not lower than 2% in 1990, 3.5% in 1991, and 5% thereafter. There was no change in the rate of return requirements for the Dams Division or for KOWACO's debt service coverage.

31. Although the Water Division's financial performance has been generally satisfactory, its financial indicators showed a decline during the years 1988-90. In 1985, the Water Division had achieved a rate of return of 6.6%, but this fell steadily, averaging only about 2% after 1987. The dip in performance resulted mainly from a doubling of its net fixed assets as new water systems became operational, the fact that in 1989 KOWACO had to take over operation of Geum Gang system which has a capacity far exceeding demand and negative net income, and the lack of tariff increases since 1987 due to EPB restrictions aimed at controlling inflation. The Dams Division achieved the covenanted rate of return in all but two years, 1988-89, when a drought affected its performance. In February 1991, the Government approved a phased 13.6% water tariff increase.

32. Although its tariff increases were restricted after 1987, KOWACO has been growing rapidly, and its operating income increased about eight times in the past seven years. KOWACO's financial performance in 1990 was good, with a debt/(debt plus equity) ratio of 40% and current ratio of 1.5. Net income was 14% of its equity, and its operating ratio was 72%. KOWACO's financial statements are given in Annex 6, Tables 1-9.

33. In 1990, raw water sales by the Water Division reached 1,373 million tons per year, which was lower than the 1,520 million tons per year forecast at appraisal, but are expected to increase rapidly particularly in the Metropolitan Region. The working ratio during 1985-90 averaged about 70%, but had reached about 76% in 1990 since the water tariff was not increased over the period. At appraisal, the working ratio was expected to average about 67% during this period with about 64% by 1990. Financial statements of the Water Division are shown in Annex 6, Tables 2-5.

34. For the Dams Division, working ratios during 1985-90 averaged about 18% (going from about 11% in 1987 to almost 26% in 1988), rather than the 13% projected at appraisal. Sharp increases in power sales in 1987 and 1990 caused the rates of return on revalued assets to reach 9.0% and 7.0%, respectively. In other years during the 1986-90 period, the rates of return were much lower (2.5% to 4.1%) because the average tariff for power sales did not increase. The actual average rate of return for the period therefore slightly exceeded the 5% agreed at appraisal, but only because of the surge in power sales. Financial statements of the Dams Division are shown in Annex 6, Tables 6-9.

35. In the near future, KOWACO's role as a development agency will diminish unless its responsibilities are expanded to include river basin management and sewage treatment and disposal as recommended (para 29). There are few possibilities for new regional water supply systems and no more major dams are planned. Thus, KOWACO would become mainly an operating agency and, from a strictly financial standpoint, there would be no need to require rates of return which would generate funds much in excess of what would be needed for good operation and maintenance and for debt service.

36. Economic Results. The Economic Rate of Return (ERR) for the project, based on existing water tariffs and project benefits which are expected to be reflected in real estate values, is estimated at about 21% (Annex 7, Table 1), somewhat higher than the 19% estimated at appraisal. Sensitivity analysis shows that a 10% decrease in benefits would reduce the ERR to 19.3% while a 15% increase in operating expenses would reduce the ERR negligibly (to 19.7%). However, these rates of return underestimate the economic benefits of the project because: (a)they are based on the average charges for treated water, which only partially represent the consumer willingness to pay for water (as evidenced by excess consumption charges up to three times higher than the average tariff); and(b)they exclude other important but difficult to quantify benefits like the provision of improved services to current consumers, the improvement of living standards, and the health and general welfare of the population. The water provided by the project is the only water source for most municipalities in the area and is therefore essential for the Region's development.

37. The Project's Impact. The project had an immediate impact on the water supplies to the project municipalities, many of which had been experiencing rationing, water shortages and low pressures. Although it became clear even before completion of the Bank-assisted third-stage system that demand would soon exceed capacity, the next stage of the system's expansion had already been planned and could be implemented without delay. There was consequently a steady improvement in the quality of service. Much, however,

remains to be done by the project municipalities, including efforts to reduce unaccounted-for water, which is reportedly about 40% in the Metropolitan Area. The results of the tariff and organizational studies should also be implemented for the full benefits of Bank involvement to be realized. The Bank is continuing its dialogue with the Government on these important matters.

Project Sustainability

38. Because of the high unaccounted-for water in the Seoul Metropolitan Region, aggressive action is required from the Government and project municipalities in implementing programs for reducing wastage through leakage. This also applies to implementation of recommendations of the cathodic protection studies carried out under the project. For the country as a whole, exploitation of water resources has gone about as far as it can, and serious actions to conserve water for municipal and industrial use are needed urgently. The recommended expansion of KOWACO's responsibilities to include river basin management and sewage treatment (para. 29) should be implemented. Furthermore, bulk water tariffs should be designed more to reflect the differences in the marginal cost of water in the different regions as a means of discouraging water use where water is scarce, rather than being based entirely on the politically expedient social considerations which have controlled tariffs decisions to date.

Bank Performance

39. Bank management performed very well at the early stages of the project, from identification through preparation, detailed design, contract packaging, procurement and project start-up. Bank management played a key role in persuading the Borrower to accept the least-cost solution. When delays occurred, Bank staff performed well and gave needed support. The Bank missions also worked hard, though unsuccessfully, to convince the Government to implement recommendations of the national water tariff studies. It is not clear whether greater involvement of the Bank at the later stages of the project would have brought about the reorganization of the sector nationwide (as recommended in the expanded MOHA study, para. 14).

Borrower and Implementing Agency Performance

40. The performance of the Borrower and implementing agencies was excellent with respect to physical implementation but slow in regard to implementing recommendations of the tariff and organizational studies. The problem in making the institutional changes proposed in the latter study has been a lack of political consensus on a reorganization of the sector. This is understandable. Since there is an ongoing dialogue on this and other matters, overall performance of the Borrower is rated satisfactory.

Project Relationships

41. The relationship of Bank staff with national, local and municipal government officials as well as with consultants working in the sector has always been very good. This project was no exception.

Performance of Consultants

42. The feasibility studies and detailed engineering for this project were satisfactorily carried out by consultants financed under the Bank's First Water Supply Project. Because of the complex engineering required for the project, MOC, on the advice of the Bank, appointed an independent review panel of international experts to review the designs and provide technical advise. This panel played a key role in reviewing the designs and contributed to the success of the physical implementation. The consultants who prepared the project designs were subsequently employed to supervise construction, which was performed satisfactorily and in a timely manner.

Performance of Suppliers and Contractors.

43. All suppliers and contractors performed well and completed deliveries on schedule.

Project Documentation and Data.

44. The project documentation and data were satisfactory.

Conclusions and Lessons Learned

45. The physical components of the project were timely and well designed, and execution was excellent.

46. There are two lessons to be learned from this project. First, good project design is crucial to the successful and timely implementation of the related physical components. Use of design panels for large, complex projects is likely to improve the projects (para. 15). Second, actions by mature Governments on politically sensitive policy changes with respect to reorganizations and tariffs are apt to come slowly, and the best role the Bank can play is to encourage and advise.

PROJECT COMPLETION REPORT
KOREA
METROPOLITAN REGION WATER SUPPLY PROJECT (LOAN 2491-KO)

PART II. PROJECT REVIEW FROM THE BORROWERS PERSPECTIVE 1/

Evaluation of the Bank's Performance and Lessons Learned

1. Bank staff had considerable experience in the sector and were recognized as professionals in all respects. All mission members had the appropriate skills for both the preparation and supervision of the project. Since this was the third project in the sector, the Bank and Borrower, represented by the government officials and the engineering consultants, worked very smoothly both in procurement and in implementation. Technical inputs from Bank professionals in contract packaging and specialized matters, such as cathodic protection, surge control and operation of large pumping stations, were especially appreciated.

2. The timing between missions (both full supervision missions and those as part of another related mission) was adequate. There were no significant delays caused by mission timing. There were changes in some mission members, but all of the staff were experienced in the sector, and there were no major problems on this account. There were also changes in government officials, but this too did not affect the project. Communications between the Bank and Borrower were satisfactory. The major lesson learned is that the somewhat greater time spent in thorough project preparation resulted in smooth implementation, without any major design changes.

Evaluation of the Borrower's Own Performance and Lessons Learned

3. The engineering consultants' staff performed satisfactorily and increased their construction management skills. The Ministry of Construction and the engineering consultants effectively organized the construction team into four offices (one for each contract) and a main field office to avoid major delays in construction. The physical facilities as originally defined were almost 90% completed by the original closing date of December 31, 1989. Both of the treatment plants were working satisfactorily, and 70% of the additional population served under the project were receiving water supply by early 1989. The delay of one year in the closing date to December 31, 1990 therefore did not result in any delay in achieving the project benefits. The principal reasons for the delay were that: i) permission for crossing the Seoul-Pusan main railway line took longer than expected; ii) extension of the Song-Pyeongtaek line was added to the project during implementation; and iii) land acquisition problems had to be resolved on this line. The project was built well within the original cost estimate, and more than US$5.0 million of the Bank loan was canceled at the Government's request since these funds were available locally.

1/ Prepared by the Borrower and presented here unchanged except for minor editing of format.

Adequacy and Accuracy of Factual Information in Part III

4. Statistical data defining the project profile were prepared by engineering and financial/economic consultants, and were reviewed in the field with a Bank mission. The many tables prepared for the PCR by the consultants formed the basis for the tables and graphs in Part III.

PROJECT COMPLETION REPORT
KOREA
METROPOLITAN REGION WATER SUPPLY PROJECT (LOAN 2491-KO)

PART III. STATISTICAL INFORMATION

Table 1: RELATED BANK LOANS

Loan Title	Purpose	Year of approval	Status	Comments
Water Supply I (Ln. 2072-KO)	Expansion of water supply in five cities (Daegu, Gwangju, Masan, Changweon, Jihae) and institutional strengthening.	1981	Completed	Main project objectives achieved; see PPAR No. 8174 of 11/89.
Water Supply II (Ln. 2350-KO)/a	Increase water supplies for municipalities in Nakdong Basin.	1983	Completed	Main project objectives achieved; see PCR No. 8675 of 5/15/90.
Namgang and Taegu Water Supply (IV) Project (Ln. 2615-KO).	Expand water supply available for Kyeongnam Province and the City of Taegu and improve coordination.	1985	Completed	PCR issued 12/19/91; being reviewed by OED.
Juam Regional Water Supply Project (Ln. 3178-KO)	Develop water supply for the Kwangju Metropolitan Area and strengthen the Kwangju Water Bureau and KOWACO	1990	Ongoing	Physical works about a year behind schedule due to inadequate allocation of counterpart funds and procurement delay. However, KOWACO's performance is satisfactory.

/a Chungju Multipurpose Project (Ln. 1666-KO) financed detailed engineering of Nakdong Barrage, which was constructed under Ln. 2350-KO.

Table 2: PROJECT TIMETABLE

Item	Date Planned	Date Revised	Date Actual
Identification (1)	-	-	02/28/83
Identification (2)	-	-	06/14/83 /a
Preparation Missions	-	-	09/20/83 /b
			01/02/84
Appraisal mission	-	-	06/10/84
Loan Negotiations	-	-	10/4/84
Board Approval	-	-	02/5/85
Loan Signature	-	-	03/11/85
Loan Effectiveness	06/11/84	-	05/07/85
Project Completion	12/31/88	12/31/89	03/31/90
Loan Closing	12/31/89	12/31/90	05/24/91

/a Date of first presentation of project to the Bank (February 2, 1983). On June 14, 1983, Bank sent comments on Feasibility Study submitted by Government.

/b There was no formal preappraisal mission.

Table 3A: LOAN DISBURSEMENT
(US$ million)

Fiscal Year	Estimated Cumulative	Actual Cumulative	Actual as % of Estimated
1985			
September 1984			
December 1984			
March 1985	0.10		
June 1985	0.20		
1986			
September 1985	2.85	7.02	246
December 1985	5.50	10.92	185
March 1986	8.20	10.99	134
June 1986	10.90	12.76	117
1987			
September 1986	16.90	22.00	130
December 1986	22.90	37.76	164
March 1987	29.40	48.54	165
June 1987	35.90	50.60	141
1988			
September 1987	43.90	54.69	125
December 1987	51.90	55.97	108
March 1988	60.40	62.95	104
June 1988	68.90	71.52	
1989			
September 1988	75.40	76.81	102
December 1988	81.90	84.71	103
March 1989	87.90	86.87	99
June 1989	93.90	87.12	93
1990			
September 1989	94.45	87.12	92
December 1989	95.00	87.77	92
March 1990	95.00	88.27	93
June 1990	95.00	88.27	93
1991			
September 1990	95.00	88.27	93
December 1990	95.00	90.00	95
March 1991	95.00		
June 1991	95.00		

Table 3B: LOAN DISBURSEMENT BY CATEGORY

The loan account was closed on May 24, 1991 and the final disbursement allocation by category is as follows:

Category	Disbursements	
	Original (US$ mln)	Final (US$)
1. Civil Works	31.0	24,980,377.48
2. Equipment and Materials	61.8	62,811,770.73
3. Consultant Services	2.0	149,562.38
Special Account-MOC	-	-286.30
Total Disbursements	94.8	89,282,424.29

Cancellations:

On April 3, 1989	$5,000,000.00
On May 1, 1991	$717,575.71
Total Cancellations	$5,717,575.71

Table 4: PROJECT IMPLEMENTATION

The progress of project execution is shown in the chart in Annex 2 and discussed in detail in Annex 3 and construction progress are shown in Annexes 2 and 3.

Table 5A: PROJECT COSTS
Revised as of March 1990
(Won Million)

Expenditure item	Appraisal estimated base cost	Contract amount	Revised contract amount	Payment (%)	Paid expenditure total	Actual Value for Previous Year Expected 1985	1986	1987	1988	1989	1990
Lot No. 1: Paldang Intake Raw Water Line	53,575.0	53,575.3	51,919.8	98.38	51,080.8	11,841.7	16,894.7	11,410.6	9,069.6	1,864.1	980.0
Civil Works	31,294.0	31,294.3	37,164.8	100.00	37,164.7	8,186.7	13,066.9	9,111.0	5,800.0	1,000.0	0.0
Equipment and Materials	22,281.0	22,281.0	14,755.1	94.31	13,916.1	3,654.9	3,927.8	2,299.7	3,269.6	864.1	839.0
Lot No. 2 Incheon System	30,632.0	28,009.1	29,524.5	98.35	29,037.7	9,470.3	4,883.9	4,839.5	8,322.4	1,521.5	486.8
Civil Works	20,814.0	10,908.1	15,444.0	100.00	15,444.0	2,683.0	3,769.0	3,115.5	4,836.2	1,040.2	0.0
Equipment and Materials	9,818.0	17,101.0	14,080.5	96.54	13,593.6	6,787.3	1,114.8	1,723.9	3,486.2	481.3	486.8
Lot No. 3 Suwon System	42,304.0	45,101.8	48,229.4	97.23	46,917.7	1,869.7	13,013.0	5,289.0	21,136.8	5,609.2	1,311.7
Civil Works	24,545.0	25,047.87	29,378.8	100.00	29,378.8	1,329.7	7,246.8	4,140.1	12,617.5	4,044.6	0.0
Equipment and Materials	17,759.0	20,054.0	18,850.6	93.04	17,538.9	539.9	5,766.2	1,148.8	8,519.3	1,564.5	1,311.7
Lot. No.4 Euijungboo S.	18,290.0	19,878.3	15,633.1	98.07	15,331.4	1,363.4	8,374.8	3,214.3	1,964.6	414.3	301.7
Civil Works	10,197.0	9,636.4	8,657.9	100.00	8,657.9	820.0	4,385.1	2,446.6	1,006.2	0.0	0.0
Equipment and Materials	8,093.0	10,242.0	6,975.2	95.67	6,673.5	543.4	3,989.7	767.6	958.4	414.3	301.7
Lot No.4-1. Han River P	0.0	2,200.3	2,157.3	98.77	2,130.7	0.0	0.0	188.4	1,933.7	8,542.0	26,577.0
Civil Works	0.0	1,900.00	1,900.0	100.00	1,900.0	0.0	0.0	0.0	1,900.0	0.0	0.0
Equipment and Materials	0.0	300.3	257.3	89.67	230.7	0.0	0.0	188.4	33,706.0	8,542.0	26,577.0
Land Acquisition and Compensation	7,900.0	13,482.0	14,656.9	100.00	14,656.9	2,391.5	4,374.8	3,072.6	2,621.3	2,196.6	0.0
Supervision	3,240.0	2,201.0	2,144.3	100.00	14,656.9	2,391.5	4,374.8	3,072.6	2,621.3	2,196.6	0.0
Other	1,340.0	19,997.0	21,359.4	100.00	21,359.4	2,941.0	3,491.5	5,859.0	8,517.6	550.3	0.0
Subtotal	157,281	184,445	186,625	98.40	182,659	30,170.3	51,577.9	34,523.2	54,127.5	12,260.1	2,965.8
Physical Contgs.	15,728	1,618	0		0	0.0	0.0	0.0	0.0	0.0	0.0
Price Contgs.	18,196	4,196	0		0	0.0	0.0	0.0	0.0	0.0	0.0
Grand Total	191,205	190,259	186,625	/a	182,659	30,170.3	51,577.9	34,523.2	54,127.5	12,260.1	2,965.8

/a US$239.32 million equivalent.

Table 5B: PROJECT FINANCING
(US$ million)

	Govt.	Bank	Total
Original Project Cost	157.1	95.0	252.1
Actual Project Cost	150.0	89.3	239.3

Table 6: PROJECT RESULTS - DIRECT BENEFITS

Total Population Benefitted after Project - 5 million
Total Incremental Population Served: 2,580,000

Year	Incremental population served (thousands)	Increase in real estate values (Won million) /a
1988	108	9,629
1989	1,304	115,892
1990	942	83,757
1991	226	20,056

/a Population/4.5 persons x W 400,000.

Table 7: ECONOMIC IMPACT

Details of calculations of the economic and financial rates of return are shown in Annex 7.

		Project completion (%)	Appraisal (%)
ERR	=	20.8	19.0
IRR	=	5.7	10.0

Table 8: FINANCIAL IMPACT

Rate of Return (percent)	1985	1986	1987	1988	1989	1990	1991
Covenanted	4.0	5.0	5.0	5.0	5.0	5.0	5.0
Actual							
Water Division	6.6	4.9	4.2	3.1	2.1	0.9	3.7
Dams Division	2.9	4.1	9.0	2.5	4.0	7.0	5.0

The lower financial rate of return for the Dams Division occurred due to a drought; the Water Division's performance was affected by the forced inclusion of an uneconomical water system and the failure to increase tariffs in a timely manner.

Table 9: STUDIES

Status of Study	Purpose	Impact of Study
1. Completed	Improve organization of water and sewer services in Metropolitan Region	Under consideration
2. Completed	Establish corporate planning within KOWACO	Under consideration
3. Completed	Set policies for bulk water tariffs at a national level	Under consideration

Table 10: USE OF BANK RESOURCES

A. Staff Inputs
(Staff Weeks)

Task	FY83	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91	FY92	Total
Preparation	8.6	18.3									26.9
Appraisal		7.0	13.5								20.5
Negotiations			11.0								11.0
Operation	1.7	3.7	10.1								15.5
Supervision			4.2	9.9	9.4	10.7	2.6	3.8	4.2		44.8
PCR Preparation				0.1					0.4	2.2	2.7
Other											0.1
Total	10.3	29.0	38.8	10.0	9.4	10.7	2.6	3.8	4.6	2.2	121.5

B. Bank Missions

Type of Mission	Dates	Staff/a	Performance Rating	Problem Types
Identification	02/28/83	Financial Analyst Engineer	-	-
Preappraisal	-	-	-	-
Appraisal	06/10/84	Financial Analyst Engineer	-	-
Supervision 1	07/24/87	Financial Analyst	-	-
Supervision 2	01/19/88	Financial Analyst Engineer	1	-
Supervision 3	04/05/88	Financial Analyst Engineers (2)	1	-
Supervision 4	05/30/89	Financial Analyst Engineer	1	-
Supervision 5	03/03/90	Financial Analyst	1	-
Supervision 6	09/24/90	Economist Engineer	1	Rate of Return

/a This list does not include many brief visits by Bank staff during project preparation and appraisal when supervising or preparing other projects in the sector.

Table 11: STATUS OF LEGAL COVENANTS

Agreement Section	Status/a	Date	Date	Description of Covenant	Comments
Loan Agreement					
3.06 (a)	OK	12/31/88	6/30/88	Cause the cities of Incheon, Bucheon and Gwangmyeong to build a joint water treatment plant.	Plant completed and in operation ahead of schedule. Satisfactory agreements reached for its operation.
3.06 (b)	OK			Municipalities to expand their distribution systems to use the water produced by the project.	All 33 municipalities have expanded their distribution systems.
3.07	OK	12/31/87	12/31/89	Government to enter into Transfer and Operation Agreement with KOWACO.	Final Transfer Agreement executed December 31, 1989.
Project Agreement					
2.04	PART	12/31/86	9/30/89	Prepare a maintenance and inspection program for overall Metropolitan Region Water Supply Systems (I, II and III).	Normal maintenance and inspection program was completed by the consultants. KOWACO also completed a study regarding corrosion protection and inspection of system pipelines, particularly I and II. Recommendations planned to be implemented in FY91.
2.05	OK	12/31/86	12/31/86	KOWACO to study strengthening its financial management and corporate planning.	Studies completed. Satisfactory semiannual plans and long-term financial projections provided to the Bank.
2.06	OK	06/30/86	11/30/87	KOWACO to study national water rates for bulk and treated water.	Studies completed satisfactorily. Recommendation to apply differential tariffs was not accepted on political and social grounds.
2.07	OK			Employ consultants for the above mentioned studies.	Completed.
4.04	PART			KOWACO to achieve annually rates of return of 5% on revalued assets.	Complied satisfactorily or exceeded until 1987. However, the drought in 1988 (lingering to 1989, and reducing power and water sales) reduced the rate of return of the Dams Div. to 2.5% in 1988. In the Water Div. the operation of an inefficient, over designed system (Geum Gang, financed by ADB) caused the return to decline to 2.1% in 1989 and 0.9% in 1990
Minutes	OK	12/31/86	12/31/86	Study the organization of water services in Metropolitan Region	Study was expanded by MOHA to include reorganization of the total water and sewerage system. Study recommendation to create river-basin corporations was not accepted by MOC. Prime Minister's Office also prepared alternative reorganization plans that were commented on by the Bank.

a: OK: Complied with.

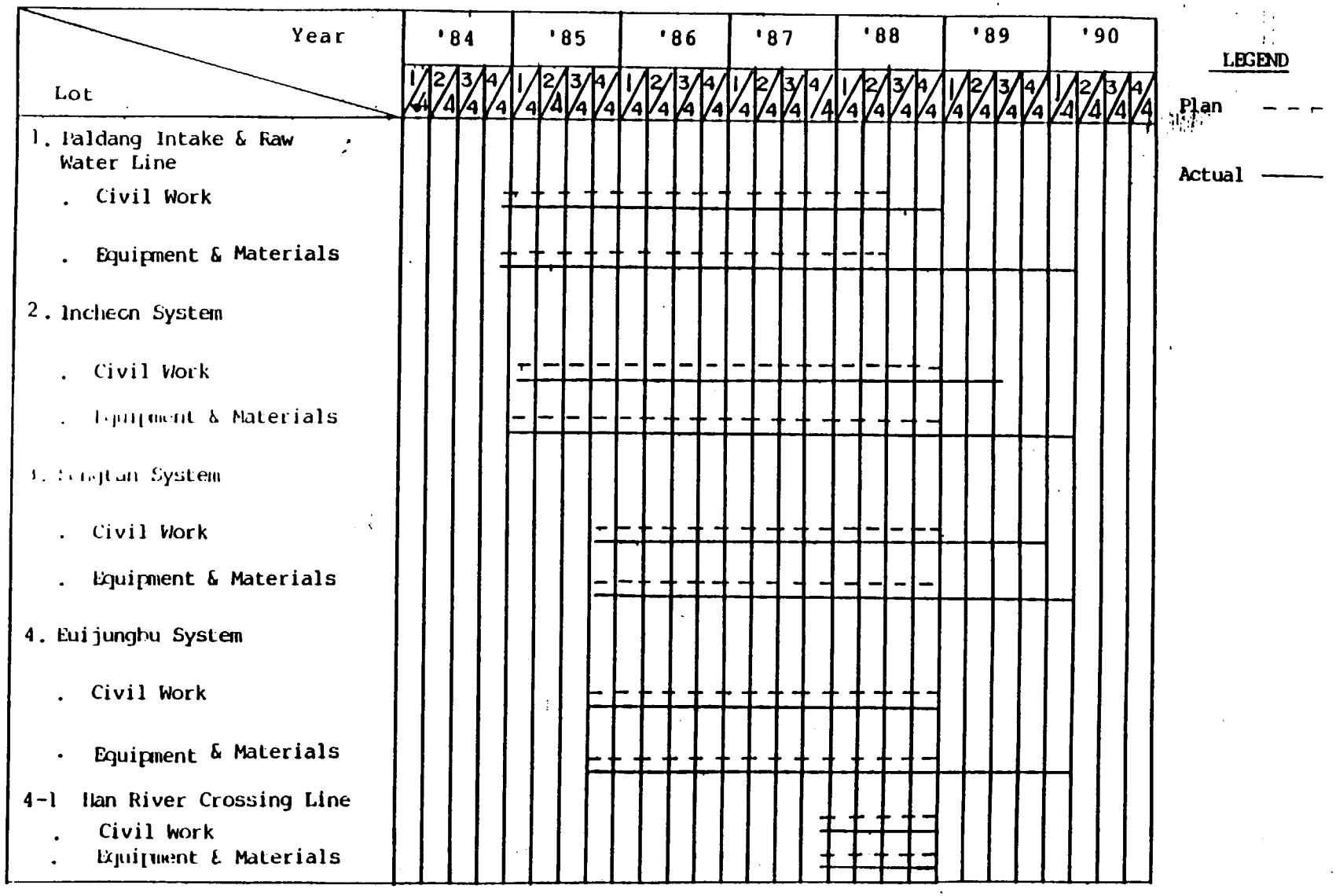
SUMMARY OF CHANGES MADE DURING DETAILED DESIGN AND PROJECT EXECUTION

Works	Project Appraisal	Detailed Design	Actual Execution
Intake Station	Paldang Intake Station: Capacity: 1,200,000 CMD Euijungbu System Intake Station: Capacity: 100,000 CMD	Paldang Intake Station: Capacity: 1,200,000 CMD Euijungbu System Intake Station: Capacity: 130,000 CMD	Paldang Intake Station: Capacity: 1,330,000 CMD Euijungbu System Intake Station: Capacity: 30,000 CMD
Trans-mission Mains	Paldang-Incheon System - Transmission Pipeline D=2,800-3,000mm L=11 km 6 places L=13 km - Tunnel D=3,800-3,000mm L=13 km	Paldang-Incheon System - Transmission Pipeline D=2,200mm 2 Lines L=11 km D=2,400-1,650mm L=30.1 km - Tunnel D=3,800 3 Places L=6.4 km D=3,200 3 Places L=5.85 km	Paldang-Incheon System - Transmission Pipeline D=2,200mm 2 Lines L=10,884 km D=2,200mm 4 Lines L=0.501 km D=2,600-1,650mm L=29.401 km - Tunnel D=3,800 3 Places L=6.558 km D=3,200 2 Places L=7.338 km
	Suwon-Pyeongtack System - Transmission Pipeline D=1,100-900mm L=24 km Euijungbu System - Transmission Pipeline D=1,100-900mm L=24 km - Tunnel D=2,000mm L=1.0 km Total Length L=126.0 km	Suwon-Pyeongtack System - Transmission Pipeline D=1,800-350 mm L=56 km Euijungbu System - Tranmission Pipeline D=1,200-1,000mm L=18.6 km - Tunnel D=2,000mm L=0.4 km Total Length L=129.05 km	Suwon-Pyeongtack System - Transmission Pipeline D=1,800-350mm L=66.225 km Euijungbu System - Transmission Pipe D=1,650-1,000mm L=29.278 km - Tunnel D=2,000 mm L=0.492 km Total Length L=149.824 km
Booster Pumping Station	Incheon System Capacity: 560,000 CMD Euijungbu System Capacity: 100,000 CMD	Incheon System Capacity: 560,000 CMD Euijungbu System Capacity: 100,000 CMD Yongin System Capacity: 20,000 CMD	Incheon System Station: 560,000 CMD Euijungbu System Capacity: 100,000 CMD Yongin System Capacity: 20,000 CMD
Water Treatment Plant	Suwon-Pyeongtack System Capacity: 425,000 CMD Euijungbu System Capacity: 100,0000 CMD	Suwon-Pyeongtack System Capacity: 425,000 CMD Euijungbu System Capacity: 130,000 CMD	Suwon-Pyeongtack System Capacity: 425,000 CMD Euijungbu System Capacity: 130,000 CMD
Acquisition of Right of Way		Implemented as Scheduled	
Design and Supervision Services		Implemented as Scheduled	

Note: 1. At the detailed design phase, two Intake Stations were planned to be constructed; a one on north of Han-River and other to the south of the River, but only the Padang Intake Station was constructed in conjunction with the construction of Paldang Bridge, and an emergency intake station was constructed to supply water in the early stage, as a supplemental intake station for Euijungbu City.

2. Diameter of pipeline was increased in a section of difficult construction, considering the future 4th stage.

PROJECT EXECUTION SCHEDULE



- Spare parts of control and instrumentations was procured during 1/4 quarter of 1990.
- 10% of retention money for the procurement of control and instrumentations, laboratory equipment and materials (chlorinator, pump, motor and electrical equipment) was paid during the year of 1990.

ANNEX 3

Construction Progress

General

1. The Metropolitan Region Water Supply Project (3rd stage) was scheduled to be completed by the end of 1989, but the completion was delayed by one year, and the closing date of that loan amount was extended to the end of 1990. Construction progress of the four lots giving reasons for delays in discussed below.

Lot No. 1

2. The intake facility works, civil works, architectural works, sanitary facilities works and electrical works were completed, and the transmission piping works and tunnelling works were already completed and raw water supplied beginning November 1988. This lot was completed on December 26, 1988 as scheduled.

Lot No. 2

3. The construction works for this lot except the Kyeongbu-railroad crossing section were almost completed by the middle of November of 1988 and raw water was supplied to the Anyang area. The raw water supply to Inchon area was commenced from June 15, 1989 because the works of the Kyeongbu-railroad crossing section was incomplete due to discussions with the Korean Rail Road Office. Other appurtenant facilities works were completed in time and Lot No. 2 was completed on August 30, 1989.

Lot No. 3

4. By the end of December of 1988, all the transmission pipeline works were complete except for about 518 m in the section of Songtan and Pyeongtack City boundary. Water supply was commenced during October of 1988; the connection to the city boundary of Songtan was made available during December of 1988. The pipeline section of about 518 m section at the Songtan and Pyeongtack city boundary, was part of a road expansion project, and was delayed due to the acquisition of land and discussions with the executing office of road construction. This lot was completed on December 20, 1989.

Lot No. 4

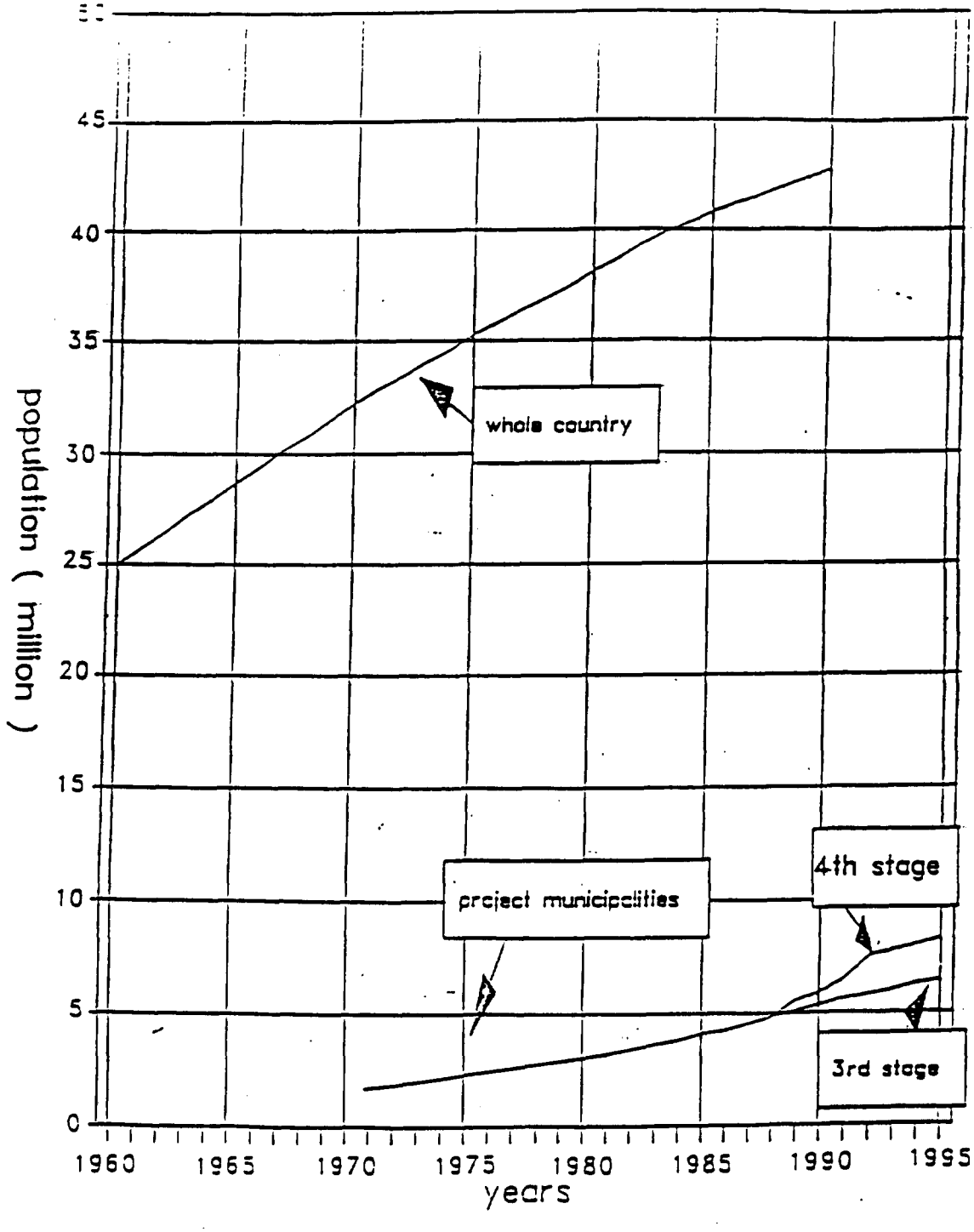
5. Euijungboo system water supply facilities were commission in early November 1987, operating from the Emergency Intake Station, and 30,000 CMD of treated water was supplied to the Euijungboo City. The Han-River crossing pipeline works were completed, and accordingly, the supply of raw water from Paldang Intake Station was commenced from December of 1988 to the Water Treatment Plant. A quantity of 100,000 CMD of treated water was supplied, by the water treatment plant. The control and instrumentation facilities works in the water treatment plant were installed and this lot was completed on December 29 1988.

Lot No. 4-1

6. The Han-River crossing pipeline works comprising, 1,9233.3 m of pipeline (D=1,200-1,650 m) and seven valve chamber were installed and protection works of wire cylinders provided. This lot was completed on December 26, 1988.

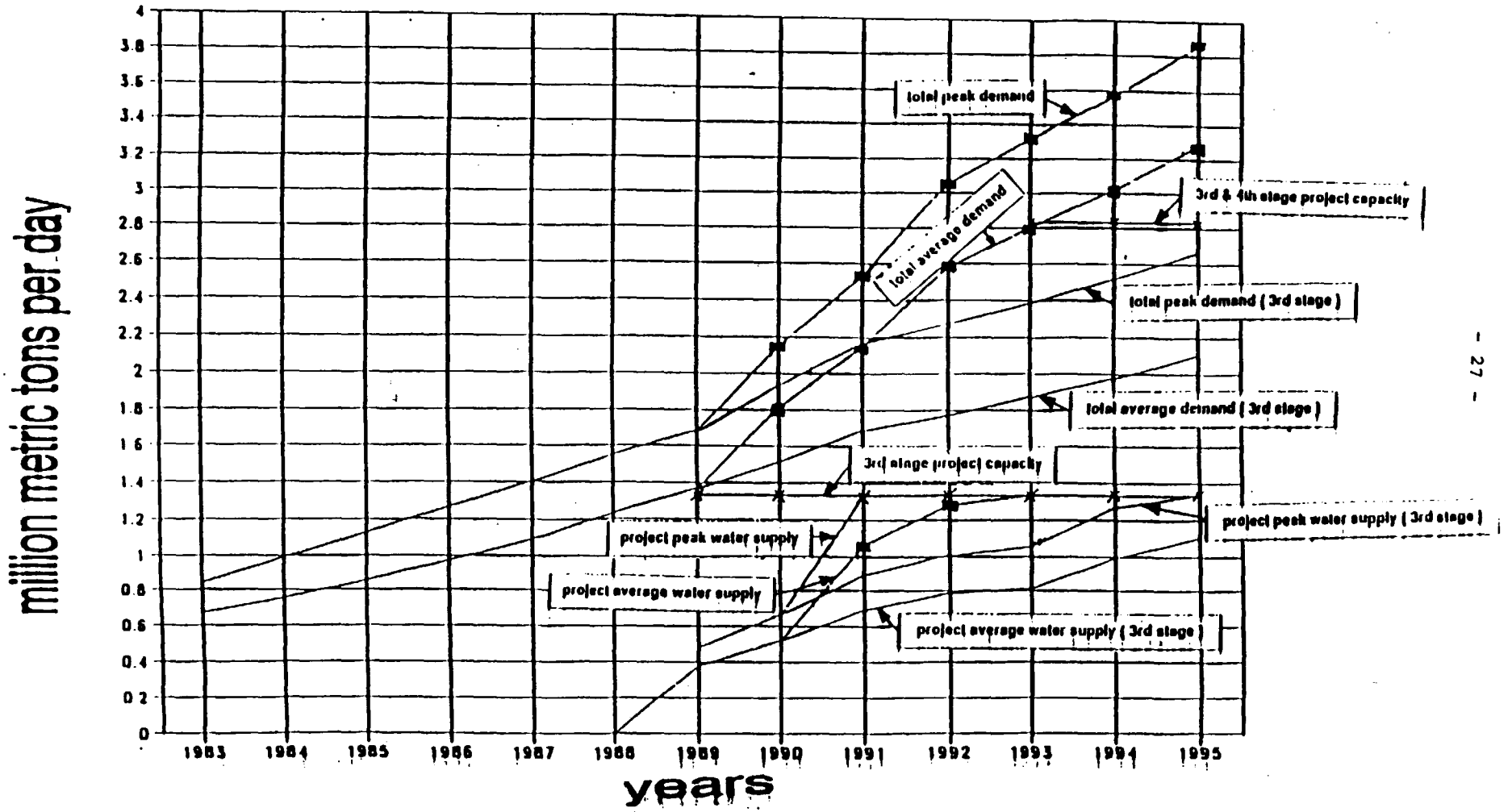
ANNEX 4

POPULATION PROJECTIONS



- When the metropolitan region water supply project (3rd stage) is evaluated, the municipalities to be supplied of water was 25 cities, but the cities to be supplied water from 4th stage of the project was increased to 32 cities.

Water Demand in Project Municipalities



* Differences of water demand between 3rd and 4th stage of the project :

ANNEX 6

Table 1: KOWACO'S SUMMARY FINANCIAL STATEMENTS (AUDITED)
(W million)

	1983	1989	1990
Operating revenue	96,987	663,518	765,045
Less: operating expenses	90,462	478,579	546,404
Operating income	6,525	184,939	218,641
Non-operating income (net)	2,794	(66,278)	(90,608)
Net income	9,319	118,661	128,033
% of operating ratio	93.3	72.1	71.4
Current assets	116,584	318,641	390,332
Deferred charges	12,809	39,975	59,472
Net fixed assets	922,897	1,663,857	1,692,104
Total Assets	1,052,290	2,022,473	2,141,908
Current liabilities	88,049	225,692	246,849
Long-term debt	381,533	553,630	542,057
Reserves	10,420	70,839	62,559
Equity	572,288	1,172,311	1,290,444
Total Equity and Liabilities	1,052,290	2,022,473	2,141,908
Current Ratio	1.32	1.41	1.58
% Debt/(debt equity)	46	42	40

ANNEX 6

Table 2: KOWACO - WATER DIVISION - INCOME STATEMENT /a
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Raw water sold (million mt)	1,118	1,134	1,124	1,164	1,345	1,373	1,560
Treated water sold (million mt)	90	106	126	188	288	390	424
Total (million mt)	1,208	1,240	1,250	1,352	1,633	1,763	1,983
% Unaccounted for Water	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Water production (million mt)	1,272	1,305	1,316	1,423	1,719	1,856	2,088
Raw Water Tariff W per mt	34.95	36.74	39.44	40.39	40.37	40.37	47.86
Treated Water Tariff W per mt	79.98	81.86	82.46	87.53	84.52	84.52	92.43
Total Average Tariff per mt	38.30	40.60	43.77	46.94	48.16	50.13	57.38
Raw Water Revenues	39,073	41,661	44,325	47,012	54,304	55,446	74,639
Treated Water Revenues	7,198	8,677	10,390	16,454	24,361	32,925	39,163
Other Revenues	0	0	0	0	0	0	0
Total Operating Revenues	46,271	50,338	54,715	63,466	78,665	88,371	113,802
Personnel	4,271	5,196	6,106	8,792	12,042	14,927	17,323
Power	16,457	17,585	17,219	20,240	23,575	25,993	30,882
Materials & Chemicals	602	664	799	1,049	1,648	2,830	3,117
Maintenance	1,210	1,524	2,485	3,954	3,923	4,183	4,634
Raw Water	4,403	4,776	6,309	6,816	7,985	8,385	9,951
Other Cost	1,503	1,885	2,316	3,579	6,658	5,638	6,245
Administration	2,028	1,865	2,028	2,985	4,401	5,416	6,285
Total Operating Expenses	30,474	33,495	37,262	47,415	60,232	67,372	78,437
Income before Depreciation	15,797	16,843	17,453	16,051	18,433	20,999	35,365
Depreciation	4,921	6,625	7,608	8,200	10,173	16,274	16,827
Operating Income	10,876	10,218	9,845	7,851	8,260	4,725	18,538
Noncash Expenses (deferred)	740	1,630	2,869	933	420	1,669	779
Operational Interest	2,052	2,851	3,805	4,767	3,495	7,649	7,483
Other Income (net)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Taxes	1,271	1,096	893	903	1,235	0	1,808
Net Income	7,813	5,641	3,278	2,248	4,110	-3,593	9,468
Ratios and Comparators							
Cost per m^3 (Won)	25.23	27.01	29.81	35.07	36.88	38.21	39.55
Working Ratio (%)	65.9	66.5	68.1	74.7	76.6	76.2	68.9
Operating Ratio (%)	78.1	82.9	87.2	89.1	90.0	96.5	84.4
Net Income on Revenues (%)	16.9	11.2	6.0	3.5	5.2	-4.1	8.3
Increases in Tariffs (%)	13.1	6.0	7.8	7.2	2.6	4.1	14.5
Increase in Operating Revenues (%)	16.2	8.8	8.7	16.0	23.9	12.3	28.8
Increase in Water Sold (%)	2.7	2.6	0.8	8.2	20.8	7.9	12.5
Average Asset's Rate Base	164,788	209,820	233,600	255,276	388,438	500,658	502,569
Rate of Return on Revalued Assets (%)	6.6	4.9	4.2	3.1	2.1	0.9	3.7

/a Fiscal year ends December 31.

ANNEX 6

Table 3: KOWACO - WATER DIVISION - SOURCE AND APPLICATIONS OF FUNDS
(W million)

	1985	1986	1987	1988	1989	1990	1991
SOURCE OF FUNDS							
Income before depreciation	15,797	16,843	17,453	16,051	18,433	20,999	35,365
Other income (+) or Expenditures	-271	-96	107	97	-235	1,000	-808
Gross Internal Cash Generation	15,526	16,747	17,560	16,148	18,198	21,999	34,557
Operational Grants (Geum Gang)	36,065	21,393		37,763	33,638		
Equity Nam Gang Project					14,611	153	
Contribution Metropolitan Project					77,939	3,159	
Borrowing							
IBRD 2615-KO (Nam Gang)					8,459	554	
IBRD 2491-KO (Metropolitan)					56,432	671	
Other Loans and Daechung (ADB->KFEB	17	25,152	0	14,391	90		
Total Borrowing	17	25,152	0	14,391	64,981	1,225	0
Total Sources of Funds	51,608	63,292	17,560	68,302	209,367	26,536	34,557
APPLICATIONS OF FUNDS							
Nam Gang Project					24,623	707	
Interest Capitalized	0	0	0	0	0	0	0
Metropolitan Project					152,333	3,830	0
Other Water Works	40,386	60,649	-6,903	55,603	40,945	12,892	0
Investment becoming deferred expense							
Total Capital Expenditures	40,386	60,649	-6,903	55,603	217,901	17,429	0
Amortization	1,123	1,805	2,431	3,529	4,108	33,498	10,471
Operational Interest	2,052	2,851	3,805	4,767	3,495	7,649	7,483
Total Debt Service	3,175	4,656	6,236	8,296	7,603	41,147	17,954
Working Capital Needs	809	324	503	793	1,371	850	2,207
Others Assets/Liabilities Changes	-513	-624	-733	-1,055	-1,445	-1,791	-2,079
Total Applications of Funds	43,857	65,005	-897	63,637	225,376	57,635	18,083
Cash Increase (+) or Decrease	7,571	-1,713	18,457	4,665	-16,010	-31,099	16,474
Debt Service Ratio	4.9	3.6	2.8	1.9	2.4	0.5	1.9
% Contribution to Investment	29.8	20.4	-167.4	14.6	4.9	-104.5	n.a.
% Capital Expenditure of Net Assets	23.3	25.4	-3.0	19.7	44.1	3.4	0.0

ANNEX 6

Table 4: KOWACO: WATER DIVISION - BALANCE SHEET
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	206,918	272,116	269,721	332,790	555,840	585,451	595,404
Accumulated Depreciation	26,162	33,232	41,405	50,055	61,201	78,775	96,942
Net Fixed Assets	180,756	238,884	228,317	282,236	494,640	506,676	498,463
Work in Progress	0	0	0	0	0	0	0
Cash & Banks	23,745	22,031	40,489	45,153	29,144	-1,955	14,519
Accounts Receivable	4,627	5,034	5,472	6,347	7,866	8,837	11,380
Inventories	820	836	863	1,016	1,076	1,140	1,197
Loans to Dams Division	232	237	244	261	277	293	308
Total Current Assets	29,424	28,138	47,067	52,777	38,363	8,315	27,404
Deferred Expenses	3,087	5,907	9,234	-1,377	-4,363	3,911	3,12
Other Assets	690	690	690	690	690	690	690
Total Assets	213,957	273,620	285,308	334,325	529,330	519,593	529,689
Accounts Payable	1,371	1,465	1,435	1,687	1,965	2,166	2,574
Other Current Liabilities	990	1,000	1,000	1,000	1,000	1,000	1,000
Current Matur. Long-Term Debt	1,805	2,431	3,529	4,108	33,498	10,471	10,471
Total Current Liabilities	4,167	4,896	5,964	6,795	36,462	13,637	14,045
Severance Reserve and Insurance	3,635	4,258	4,991	6,046	7,491	9,282	11,361
Long-Term Debt (net)	15,826	42,996	45,662	46,267	75,184	75,879	65,408
Total Liabilities	23,627	52,151	56,617	59,108	119,137	98,799	90,813
Assets Revaluaition Surplus	0	4,104	8,048	14,4	19,240	30,121	38,735
Operational Surplus (+)	7,813	13,455	16,733	18,981	23,092	19,499	28,967
Capital	182,517	203,910	203,910	241,673	367,861	371,174	371,174
Total Equity	190,330	221,469	228,691	275,218	410,192	420,794	438,876
Total Equity and Liabilities	213,957	273,620	285,308	334,325	529,330	519,593	529,689
Current Ratio	7.1	5.7	7.9	7.8	1.1	0.6	2.0
Working Capital, exclud. cash	3,318	3,641	4,144	4,937	6,255	7,105	9,312
% Debt on Debt plus Equity	8.5	17.0	17.7	15.5	20.9	17.0	14.7
Days Accounts Receivable (No.)	37	37	37	37	37	37	37
% Debt/(Net Fixed Assets + WIP)	10	19	22	18	22	17	15

ANNEX 6

Table 5: KOWACO: WATER DIVISION - MONITORING INDICATORS
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Demand							
Raw Water Sold (million mt)	1,118	1,134	1,124	1,164	1,345	1,373	1,560
Treated Water Sold (million mt)	90	106	126	188	288	390	424
Total Water Sold (million mt)	1,208	1,240	1,250	1,352	1,633	1,763	1,983
Water Production (million mt)	1,272	1,305	1,316	1,423	1,719	1,856	2,088
Management							
Day Account Receivable (No.)	37	37	37	37	37	37	37
Treated Water Tariff (W/mt)	79.98	81.86	82.46	87.53	84.52	84.52	92.43
Total Average Tariff (W/mt)	38.3	40.6	43.8	46.9	48.2	50.1	57.4
Increae Total Average Tariff (%)	13.1	6.0	7.8	7.2	2.6	4.1	14.5
Working Ratio (%)	65.9	66.5	68.1	74.7	76.6	76.2	68.9
Contribution to Investment (%)	29.8	20.4	-167.4	14.6	4.9	-104.5	n.a.
Rate of Return (%)	6.6	4.9	4.2	3.1	2.1	0.9	3.7
Debt Service Ratio (%)	4.9	3.6	2.8	1.9	2.4	0.5	1.9
Debt on Debt Plus Equity (%)	8	17	18	15	21	17	15

ANNEX 6

Table 6: KOWACO: DAMS DIVISION - INCOME STATEMENT /a
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Sales of Services							
Mun. and Ind. Water Rights (million tons)	1,409	1,543	1,546	1,706	2,293	2,714	2,700
Power sales (GWh)	928	1,369	2,238	1,145	1,598	2,490	1,807
Irrigated Land (ha)	240	240	1,520	2,094	2,733	3,307	3,881
Average Rates							
Mun. and Ind. Water Rights (W/mt)	4.70	4.76	5.94	5.95	6.29	6.27	6.14
Power (W/kWh	28.89	37.98	37.46	37.30	37.73	37.71	45.33
Irrigated Land (W million/ha	0.02	0.02	0.02		0.02	0.02	0.02
Revenues							
Municipal and Ind. Water	6,617	7,338	9,183	10,155	14,422	17,016	16,579
Power Sales	26,807	51,999	83,828	42,713	60,288	93,897	81,889
Irrigated Land Rights	5	5	5	6	6	6	6
Total Operating Revenues	33,429	59,342	93,017	52,873	74,715	110,919	98,474
Personnel	2,791	4,420	4,804	6,192	7,178	8,035	9,298
Power	410	649	526	593	550	500	739
Maintenance	525	1,179	1,973	2,040	2,432	3,574	5,038
Other direct expenses	870	1,835	1,872	2,729	2,744	3,638	4,745
Administration	1,300	2,268	1,417	2,148	2,457	2,866	3,476
Total Operating Expenses	5,896	10,351	10,592	13,702	15,361	18,613	23,296
Income Before Depreciation	27,533	48,991	82,425	39,171	59,354	92,306	75,178
Depreciation	14,001	20,241	20,667	21,972	27,600	29,263	29,760
Operating Income	13,532	28,750	61,758	17,200	31,754	63,043	45,418
Noncash Expenses (deferred)	3,001	13,128	21,209	12,028	8,194	14,168	8,890
Operational Interest	2,432	22,173	22,183	19,546	22,450	22,910	21,180
Other Income (net)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Taxes	1,365	0	2,905	0	514	6,571	4,395
Net Income	7,733	-5,551	16,460	-13,374	1,597	20,394	11,953
Ratios and Comparators							
Working Ratio	17.6	17.4	11.4	25.9	20.6	16.8	23.7
Operation Ratio	68.5	73.7	56.4	90.2	68.5	55.9	62.9
Net Income on Revenues (%)	23.1	-9.4	17.7	-25.3	2.1	18.4	12.1
Increase in Operating Revenues (%)	54.7	77.5	56.7	-43.2	41.3	48.5	-11.2
Increase in Power Sold (%)	35.3	47.5	63.5	-48.8	39.6	55.8	-27.5
Average Asset's Rate Base	489,665	697,004	689,918	699,261	801,486	903,486	908,439
Rate of Return on Revalued Assets (%)	2.8	4.1	9.0	2.5	4.0	7.0	5.0

/a Fiscal year ends December 31.

ANNEX 6

Table 7: KOWACO: DAMS DIVISION - SOURCES AND APPLICATIONS OF FUNDS
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Sources of Funds							
Income before depreciation	27,533	48,991	82,425	39,171	59,354	92,306	75,178
Other income (%) or Expenses	-198	1,265	-1,617	1,372	917	-5,089	-2,874
Land reclamation (Nakdong)	0	0	29,324	16,995	73,609	19,344	14,665
Transmission Line (from KEPCO)	1,565						
Gross Internal Cash Generation	28,900	5,0256	110,132	87,538	133,880	106,561	86,969
Chungju	41,369	4,223					
Nakdong	17,200	16,165	4,759				
Hapcheon	130,029	14,177	2,456	6,728			
OECF - Juam	20,817	33,445	37,580	6,2801	52,910	26,677	71,190
Imha	3,594	19,640	15,955	38,564	33,433	24,955	85,675
Namgang					548	32,836	39,823
Other Dams						3,071	15,804
Total Equity Contributions	96,009	87,659	60,750	108,093	86,891	87,539	212,492
IBRD-Nakdong (2350-KO)	13,924	15,326	4,939	0	0	0	0
OECF - Hapcheon	14,195	14,191	13,853	6,057	0	0	0
OECF - Juam	0	0	19,357	3,958	2,195	11,893	12,639
OECF - Imha	0	0	8,823	4,345	9,100	1,152	5,958
Oil Fund	0	20,000	30,000	30,000	0	0	0
IBRD-Chungju (1666-KO) + premature repayment	5,305	666	0	31,687	0	0	0
OECF - Chungju	2,458	388					
KDB Loans	27,600	13,725	13,725	5,000	0	0	0
Total Borrowing	63,482	64,307	90,697	81,047	11,295	13,045	18,597
Total Sources of Funds	188,391	202,222	261,579	276,678	232,066	207,145	318,058
Application of Funds							
Nakdong Barrage	42,464	47,887	50,807	20,644	8,369		
Chungju Dam	56,841	5,449	0		20		
Hapcheon Dam	67,600	63,888	41,570	31,267	4,513		
Juam Dam	20,817	33,523	78,390	72,627	53,401	38,138	56,426
Imha Dam	3,594	41,268	29,512	75,455	39,751	26,122	35,492
Namgang				0	548	32,386	39,823
Invest. to become defer. 174	336	710	1,411	1,669	2,379	3,383	23,649
Other Dams						2,768	15,804
Total Capital Expenditures	191,652	192,725	201,690	201,662	108,981	102,797	171,194
Amortization	16,103	19,794	25,154	125,383	30,670	35,376	33,038
Operational Interest	2,432	22,173	22,183	19,546	22,450	22,910	21,180
Total Debt Service	18,535	41,967	47,337	144,929	53,120	58,286	54,218
Working Capital Needs (+)	1,976	-14,662	-1,963	5,047	7,039	3,625	-1,142
Other Assets/Liabilities Changes	-29,167	-24,265	5,712	-80,372	56,569	34,518	34,479
Total Applications of Funds	182,996	195,765	252,776	271,267	225,710	199,226	258,749
Cash Increase (+) or Decrease	5,395	6,458	8,803	5,411	6,356	7,919	59,309
Debt Service Ratio	1.6	1.2	2.3	0.6	2.5	1.8	1.6
Contribution to Investment (%)	19.6	24.5	29.3	8.9	15.7	9.9	-0.3
Capital Expend. of Net Assets (%)	27.3	27.8	29.4	28.3	12.2	11.2	19.0

ANNEX 6

Table 8: KOWACO: DAMS DIVISION - BALANCE SHEET /a
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	737,129	749,676	765,444	813,767	1,022,221	1,083,813	1,102,238
Accumulated Depreciation	35,972	56,825	78,458	102,230	130,786	168,276	200,897
Net Fixed Assets	701,156	692,851	686,986	711,536	891,435	915,537	901,341
Work in Progress	120,867	217,988	439,092	497,092	359,236	461,253	0
Cash	26,259	32,717	41,519	46,931	53,287	61,206	120,515
Accounts Receivable	6,158	6,544	6,575	7,064	8,304	9,305	9,848
Inventories	1,011	1,372	1,454	1,696	1,798	1,906	2,000
Other Current Assets	575	610	646	685	726	770	820
Total Current Assets	34,004	41,243	50,195	56,376	64,115	73,187	133,183
Deferred Expenses	16,622	53,534	76,107	19,379	-9,641	18,736	33,495
Special Fixed Assets (not for ROR)	0	113,149	113,149	246,248	311,823	311,823	311,823
Other Assets (Insurance, etc.)	600	865	1,154	1,525	1,956	2,438	2,958
Long-Term Accounts Received (MOC)	6,282	6,282	6,282	6,282	6,282	6,282	6,282
Total Assets	873,249	1,006,481	1,253,533	1,285,908	1,307,100	1,471,151	1,070,977
Accounts Payable	1,013	1,382	1,492	1,837	2,004	2,349	2,349
Contractor's Payable	0	15,075	17,077	12,454	6,630	3,814	5,643
Current Matur. Long-Term Debt	19,794	25,154	125,383	30,670	35,376	33,038	40,100
Total Current Liabilities	20,807	41,611	143,952	44,961	44,010	39,201	48,092
Loan from the Other Divisions	29,000	53,000	47,000	127,000	70,000	35,000	0
Long-Term Debt (net)	288,927	328,080	293,394	343,771	319,690	299,697	278,194
Other Debt (Allowance)	1,200	1,731	2,307	3,050	3,912	4,876	5,917
Total Liabilities	339,934	424,422	486,653	518,782	437,612	378,774	332,203
Assets Revaluation Surplus	-63	9,822	20,096	34,093	38,672	90,102	101,887
Operational Surplus (+)	16,499	10,948	27,408	14,034	15,631	36,024	47,977
Capital	516,878	561,290	719,376	718,998	815,186	966,251	588,910
Total Equity	533,314	582,059	766,880	767,125	869,488	1,092,377	738,774
Total Equity and Liabilities	873,249	1,006,481	1,253,533	1,285,908	1,307,100	1,471,151	1,070,977
Current Ratio	1.6	1.0	0.3	1.3	1.5	1.9	2.8
Workign Capital, excluding cash	6,731	-7,930	-9,893	-4,846	2,193	5,818	4,676
Debt on Debt plus Equity (%)	39.4	42.2	35.1	34.6	28.3	21.6	26.9
Days Account Receivable (No.)	67	40	26	49	41	31	37
Debt/Net Fixed Assets + WIP) (%)	42	47	37	34	27	22	30

/a Fiscal year ends December 31.

ANNEX 6

Table 9: KOWACO: DAMS DIVISION - MONITORING INDICATORS
(Won million)

	1985	1986	1987	1988	1989	1990	1991
Demand							
Mun. & Ind. Water Rights (million tons)	1,409	1,543	1,546	1,706	2,293	2,714	2,700
Power Sales (GWh)	928	1,369	2,238	1,145	1,598	2,490	1,807
Irrigated Land (ha)	240	240	1,520	2,094	2,733	3,307	3,881
Management							
Numbe of Days Accounts Receivable	67	40	26	49	41	31	37
Number of Employees	381	539	539	539	639	659	659
Increase Number of Employees (%)	100.3	141.5	100.0	100.0	118.6	103.1	100.0
Financial							
Average Rates							
Mun. & Ind. Water Rights (W/mt)	4.70	4.76	5.94	5.95	6.29	6.27	6.14
Power (W/kWh)	28.89	37.98	37.46	37.30	37.73	37.71	45.33
Irrigated Land (W/ha)	20,880	20,880	20,880	20,880	20,880	20,880	20,880
Working Ratio	17.6	17.4	11.4	25.9	20.6	16.8	23.7
Contribution to Investment (%)	19.6	24.5	29.3	8.9	15.7	9.9	-0.3
Rate of Return (%)	2.8	4.1	9.0	2.5	4.0	7.0	5.0
Debt Service Ratio	1.6	1.2	2.3	0.6	2.5	1.8	1.6
Debt on Debt plus Equity (%)	39	42	35	35	28	22	27

ANNEX 7

Table 1: ECONOMIC RATE OF RETURN (ERR) BASED ON BULK WATER TARIFF
(W million)

Year	Project cost	Operation cost	Total cost	Water sold	Average tariff	Water revenue	Other benefits	Total Benefits	Net Benefits
1985	27,831		27,831						-27,831
1986	50,286		50,286						-50,286
1987	32,300		32,300						-32,300
1988	54,262	555	54,817	16.9	76.21	1,288	9,629	10,917	-43,900
1989	12,345	6,027	18,372	220.3	60.17	13,256	115,892	129,148	110,776
1990	2,599	12,908	15,507	367.3	52.08	19,128	83,757	102,885	87,378
1991		15,215	15,215	402.5	69.70	28,055	20,056	48,111	32,896
1992-2029		15,215	15,215	402.5	69.70	28,054		28,054	12,839
					ERR	=	0.207829		

Other Benefits

Total Incremental Population: 2,580,000

Year	Incremental population served (thousands)	Increase in real estate value /a
1988	108	9,629
1989	1,304	115,892
1990	942	83,757
1991	226	20,056

Sensitivity Analysis	ERR (%)
Benefit reduced by 10% after 1990	19.31
Operational expenses increased by 15% after 1990	19.73

/a Population/4.5 person x W 400,000

Table 2: INTERNAL FINANCIAL RATE OF RETURN (IRR) BASED ON BULK WATER TARIFF
(W million)

Year	Project cost /a	Operation cost /b	Total cost	Water sold/c	Average tariff /d	Water revenue	Net benefits
1985	27,831		27,831				-27,831
1986	50,286		50,286				-50,286
1987	32,300		32,300				-32,300
1988	54,262	555	54,817	16.9	76.21	1,288	-53,529
1989	12,345	6,027	18,372	220.3	60.17	13,256	-5,116
1990	2,599	12,908	15,507	367.3	52.08	19,128	3,621
1991		15,215	15,215	402.5	69.70	28,055	12,840
1992-2029		15,215	15,215	402.5	69.70	28,054	12,839
					IRR	-	0.057031

Sensitivity Analysis

	IRR (%)
Benefit reduced by 10% after 1990	4.23
Operational expenses increased by 15% after 1990	4.52

/a Actual investment cost.

/b KOWACO's actual cost allocated for Third Stage Project.

/c Actual water sold until 1990 and thereafter 85 percent of capacity for raw water and 80 percent of capacity for treated water.

/d Actual tariff increased at 13.6 percent on February 1, 1991 raw water from W 38.03/ton to W 43.22/ton, treated water from W 77.14/ton to W 87.55/ton.

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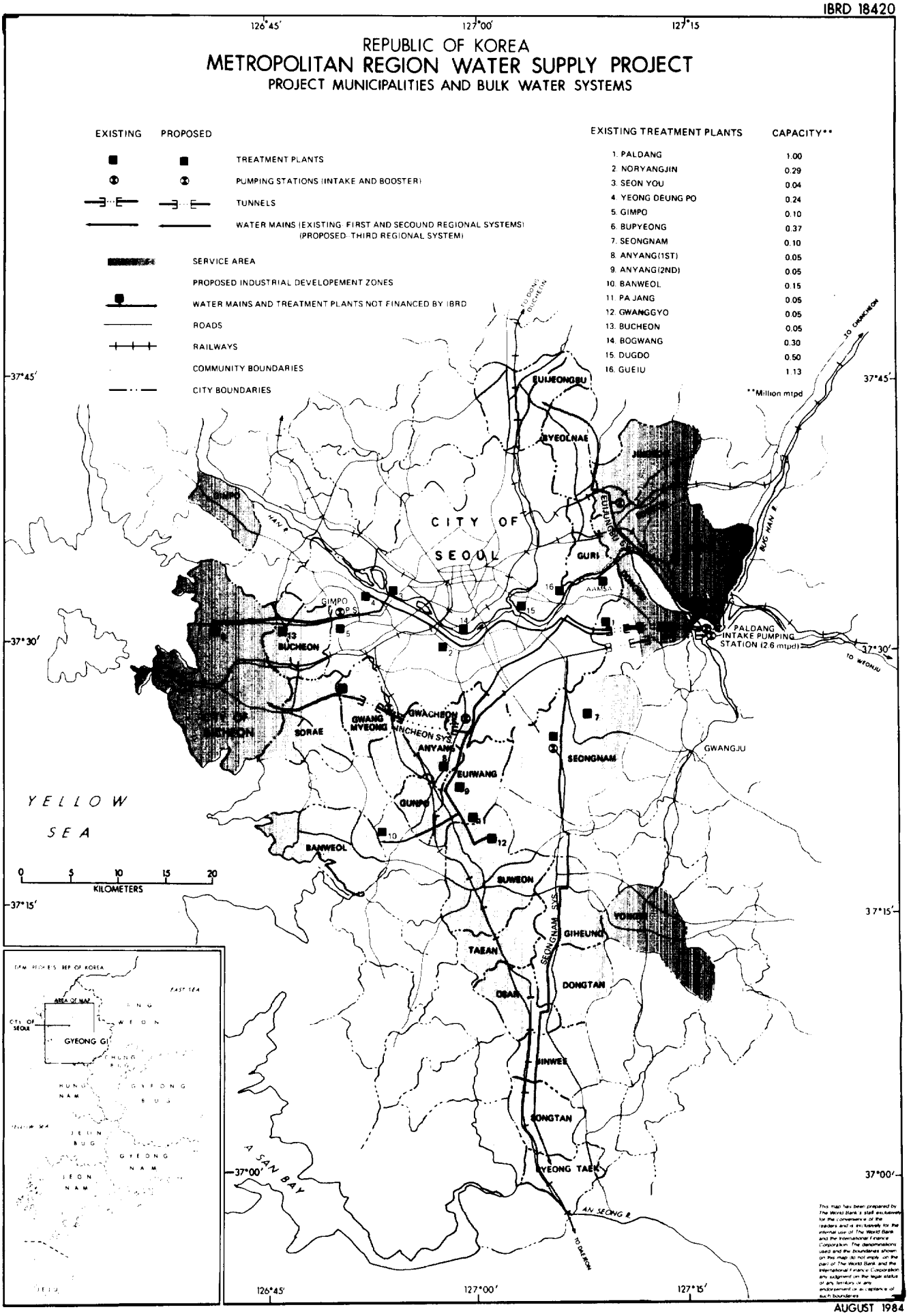
METROPOLITAN REGION WATER SUPPLY PROJECT
PROJECT MUNICIPALITIES AND BULK WATER SYSTEMS



AUGUST 1984